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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM--
SOVIET-BLOC ACTIVITIES

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Sputnik III Completes 7,000th Revolution

The third Soviet artificial earth satellite completed its 7,000th revolution around the Earth on 21 September at 1855 Moscow time. During the 495 days of its existence, it has traveled over 316.8 million kilometers.

The satellite's orbital parameters have altered considerably during this time: its orbital period has shortened from 105.95 minutes down to 97.2 minutes, a decrease of 8.75 minutes. Its apogee has decreased by 830 kilometers and, on its 7,000th revolution, was equal to 1,050 kilometers.

The radio transmitter "Mayak" installed in the satellite continues to operate steadily. Radiotechnical and optical observations are being successfully carried out. ("7,000 Revolutions Around the Earth," Tass report; Moscow, Pravda, 21 Sep 59, p 4)

Lunar Findings Support Frenkel' Theory

The lack of a magnetic field near the Moon, a fact established by the apparatus carried by the second Soviet cosmic rocket, is of great scientific value to Man in understanding many geophysical phenomena, particularly in studying the nature of terrestrial magnetism, write S. Brodskaya and V. Zhilyayeva, scientific associates, in Sovetskaya Aviatsiya.

The Earth's magnetic field includes permanent and variable components having different causes. The origin of the permanent part of the Earth's magnetic field has not yet been explained. Many hypotheses exist, of which that of Ya. I. Frenkel', noted Soviet scientist, is, according to the writer's, the most acceptable. According to this theory, the Earth's core is a liquid metallic medium with a small quantity of radioactive matter. In these conditions, convective movements, supported by the energy of the decay of radioactive elements, can arise in the Earth's core. In the presence of even a very weak magnetic field, induction currents arise in the moving metallic mass which can cause a secondary magnetic field intensifying the primary field. In this case, the Earth's core can be compared to the operation of a self-excited generator.

It is impossible to test any of these theories by observations on the Earth's surface. Scientists hope that investigations with the aid of satellites and rockets will aid in solving this problem, say the writers, by means of comparing the magnetic fields of celestial bodies, particularly, the magnetic field of the Moon.

The writers say that today, scientists assume that the Moon has no liquid center. On the other hand, they say, the instruments of the Soviet cosmic rocket showed that there is no magnetic field around the Moon. Comparing these facts, they conclude that the origin of the terrestrial magnetic field is connected with the phenomena originating in the Earth's liquid core. Thus, they say, it is possible to assume that the Frenkel' hypothesis on the origin of the permanent components of the Earth's magnetic field has received its first scientific basis.

It is especially important, say the writers, to study the reasons for perturbations of the magnetic field inasmuch as they cause disruptions of radio communication. It is also necessary to consider the fact that, in future flights near the Moon, instruments, the operation of which is based on the use of magnetic forces, cannot be used aboard space ships. Instruments will be required which are based on other principles. ("Secrets of Terrestrial Magnetism Are Revealed," by S. Brodskaya and V. Zhilyayeva; Moscow, Sovetskaya Aviatsiya, 23 Sep 59, p 4).

II. UPPER ATMOSPHERE

Pulkovo Observatory Expands Studies of Moon and Planets

Pulkovo astronomers are conducting a whole complex of scientific studies of the Moon, said A. A. Mikhaylov, Corresponding Member of the Academy of Sciences USSR, director of the Pulkovo Observatory, in an interview with a Tass correspondent.

This celestial body has become of greater interest than ever before to everyone since the launching of the first Soviet artificial earth satellites and the later launching of cosmic rockets which culminated in the reaching of the lunar surface.

In the observatory, the newest methods are employed in making measurements of the Moon's temperature in its different phases, studies of the polarization of light reflected from separate parts of the surface, etc.

A detailed investigation of the phenomena of the flowing of gases from the Crater of Alphonsus, recently discovered by the Pulkovo astronomer N. A. Kozyrev, is continuing. There is reason to assume, says Mikhaylov, that vulcanism on the Moon is not an episodic phenomenon and, therefore, Kozyrev will shortly continue his studies in this direction.

The photographic observation of the Moon on the background of the surrounding stars was begun some time ago in Pulkovo by Kh. I. Potter, chief astronomer. A special method of observation was adapted on the standard astrograph. The object of this work is to more accurately define the theory

of the movement of the Moon and to study the irregularity in the Earth's rotation which is caused by the shifting of masses on the Earth's surface and inside of it. More than 200 photographs have already been obtained. Measurements of the Moon's coordinates have been made using an instrument created by N. F. Bystrov, an associate of the observatory. It was established that now the Earth lags, according to time, behind its own rotation period by 32 seconds. This is of great value in observations of solar eclipses, the flight of cosmic rockets, and the studies of cosmic space.

The problem of studying the bodies of the solar system exposed the need to create a special planetary division in the Pulkovo Observatory, said Mikhaylov. Such a division has now been created. One of the problems to be solved by its associates is the detailed study of the Moon, its nature, and the structure of its surface. A large double refractor will be installed in the high mountain station of the Pulkovo Observatory near Kislovodsk for this purpose. Pulkovo itself already has two objectives with diameters of 76 and 82 centimeters for this. According to Mikhaylov, it is also planned to establish a 1.5-meter reflector to be used for studying the Moon and the planets in one of the observation areas. ("With the Pulkovo Astronomers," by A. A. Mikhaylov; Moscow, Sovetskaya Aviatsiya, 17 Sep 59, p 2)

III. METEOROLOGY

Actinometric Research of the Polish Expedition to Vietnam

The following information on radiation research conducted by the Polish IGY Expedition to Vietnam is given by Janusz Paszunski, Institute of Geography, Polish Academy of Sciences, Warsaw.

Two actinometric stations were installed, one at the Vietnamese-Polish Observatory of Phy-lien in the Red River delta (20.8 N, 106.6 E, 115 meters above sea level) and one at the Meteorological Station at Sa-Pa in the mountains of the northwestern part of the country (22.3 N, 103.8 E, 1,570 meters above sea level). The following observations were conducted at both of these points: records of total and diffuse radiation using Moll-Gorczynski solarimeters, records of duration of sunshine by means of Campbell-Stokes and Jordan heliographs, and systematic measurements (every half-hour or hour, respectively) of the intensity of direct solar radiation by means of thermoelectric Moll-Gorczynski actinometers and a bimetal Michelson-Marten actinometer. The latter measurements were made both for the whole solar spectrum and for defined spectral regions using the standard color filters OG 1, RG 2, and RG 8, 525, 630, and 700 millimicrons, respectively. In addition, systematic measurements of the intensity of short-wave radiation reflected on various types of surfaces were also made, using a Moll-Gorczynski solarimeter.

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For the periodic calibration of the instruments serving for measuring short-wave radiation, an Angstrom compensation pyrheliometer and a Linke-Feussner actinometer were used. Sporadic measurements of long-wave radiation were made by means of an Angstrom pyrgeometer.

The hourly and diurnal amounts of short-wave radiation -- global, diffuse, and direct -- on a horizontal surface were obtained. The hours of bright sunshine, the instantaneous intensity values of direct solar radiation on a perpendicular surface, and albedo values for various kinds of natural surfaces were also obtained.

These data can serve for comparison of radiation conditions in physiographically different parts of Vietnam. They form a basis also for research on the transparency of the atmosphere with consideration of single spectral parts. Such research, by taking into account aerologic results, allows the numerical part of the individual factors in atmospheric extinction, i.e., the selective absorption due to water vapor and scattering by suspended particles, to be determined.

Measurements of direct solar radiation in different spectral regions were made twice during the voyage on the route Baltic-Atlantic-Indian Ocean-South China Sea -- once around Africa, and once through the Suez Canal. ("Actinometry in the Research Work of the Polish Expedition to Vietnam, IGY 1957-1958," by Janusz Paszynski; Warsaw, Acta Geophysica Polonica, Vol 7, No 2, 1959, pp 230- 236)

IV. SEISMOLOGY

Strong Earthquake Rocks Lake Baykal Region

During the night of 30 August 1959, the region of Lake Baykal experienced a strong earthquake. Tremors were felt at Ulan-Ude, Irkutsk, and other points. According to preliminary data, the epicenter was located in the central Baykal region, on the sparsely inhabited southeast shore, near the Selengi River delta. First tremors were recorded at 0111 local time. Force of the earthquake at the epicenter was believed to have reached a scale intensity of 8-9. The last strong earthquake in this region was registered on 12 January 1862, when an intensity of 9 was recorded. ("Earthquake in the Region of Baykal" (unsigned article); Moscow, Sovetskaya Aviatsiya, 1 Sep 59, p 4)

Development of Seismology in Communist China

A report on the development of seismology in Communist China by D. Kharin, Candidate of Physicomathematical Sciences, which appeared in a Soviet periodical, follows in full.

"Cooperation between the seismologists of the People's Republic China and of the Soviet Union is strengthened more and more with each passing year. This is due, not only to the geographic nearness of the two countries, but also to their community of scientific interests. The equipping of seismic stations in China and the USSR with identical apparatus facilitates comparison of the results of observations. A plan for a systematic exchange by means of seismic bulletins has been set up, and a plan of joint investigations has been designated. The yearly visits of Chinese scientists to the USSR and of Soviet scientists to China ensure close personal contacts between them.

"During the recent 2-month stay in China, B. A. Petrushevskiy, N. V. Shebalin, and I [D. Kharin, the author] became acquainted with the conduct of seismic investigations by Chinese seismologists and also took part in evolving a prospective plan for their development.

"A comparison of the work previously fulfilled with current work shows that seismology in China has entered into a new stage of development. The principal work previously conducted consisted mainly in the collection of information concerning the earthquakes in the territory of China during the many centuries of its history. An extensive catalogue of earthquakes was compiled. This catalogue, together with a very general (up to now) calculation of the tectonics, is the basis for maps of seismic regioning of the territory of China. A reference network of 18-20 seismic stations equipped

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with instruments for recording near and distant earthquakes (D. P. Kirnos type seismographs) is near completion. This network should ensure the recording of all earthquakes with a scale intensity of $M > 4 \frac{1}{2}$ in the territory of China. Engineering-seismological investigations were begun with detailed examinations of the destructive aftereffects of strong and catastrophic earthquakes of former years.

"It is possible to consider 1958 as the beginning stage of the work when the Second Five-Year Plan for seismic investigations was drawn up. In connection with the rapid development of the country's economics and the varied problems of the economy, new, complex and pressing problems requiring the expansion of earlier-initiated investigations arose before seismologists.

"The detailed instrumental study of the seismicity of the region for the building of dams on the Yangtze River and investigations of the seismic effect of explosions; the study of the extensive territory and highly active seismicity of the Kansu corridor and the adjoining regions, with the aim of developing a more basic methodology for the seismic regioning of the territory and the prediction of earthquakes, must be treated as the basic problems.

"The Yangtze is the largest river in China and has one of the highest water discharges in Asia. At the spot where the Yangtze cuts through the Huang-li anticline and escapes from the mountains into the lowlands, the construction of the largest dam in the world is planned. The purposes of this grandiose installation are flood control, the production of electric power, and the improvement of conditions for navigation and irrigation. The height of the gravity dam on the Yangtze will be 200 meters, and the installed capacity of the generators will be several times larger than those in the Bratsk hydroelectric station.

"Now, surveys are being conducted for different sites for the hydro-electric station. One of the most promising of the sites is located in the lower paleozoic limestones; the other is located upstream in the igneous rock in the center of the anticline. There is no information on destructive earthquakes in this region. The nearest epicenters of strong earthquakes are located 200 kilometers from the dam. On the map of seismic regioning of the territory of China, the region lies in a zone with a scale intensity of 6, where, as is known, no additional earthquake precautions are necessary during construction.

"However, in connection with the uniqueness of the structure, the problem of supplementary instrumental and seismogeological studies of the seismicity of this region was placed before Chinese seismologists and geologists. For this purpose, in the region allocated for the dam sites, the immediate organization of a network of five to six seismic stations is planned. These will be equipped with highly sensitive apparatus having the capability of

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recording and localizing the epicenters of the weakest earthquakes ($M < 3$). The first of such stations, near the city of I'ch'ang, has already been conducting regular observations since mid-September 1958. Judging from the material of this station, the seismic activity of the region is not great.

"In 1959, four to five additional similar stations will be opened. These will be spaced 40-60 kilometers apart. They will embrace the entire region of construction and make it possible, with sufficient accuracy, to determine the coordinates of local earthquake epicenters. The conduct of an extensive seismo-geological examination of the vast region surrounding the region of the dam is planned.

"To accelerate construction, especially the construction of the very long navigable locks, blasting operations are planned, during which, at times, thousands of tons of explosives will be set off simultaneously in the excavation rock.

In this connection, the problem arose of studying the seismic effect (concussions) of the ground and its possible sinking during the explosions, particularly, of estimating the blast danger to underground and aboveground hydroengineering installations. This work was also entrusted to the seismologists. For this purpose, Chinese industry is now familiarizing itself with the production of the necessary measuring apparatus (vibrographs, magnetolectric oscillographs, etc.)

A series of powerful hydroelectric stations is projected for the upper and middle course of the Yellow River, the basin of which also has great value in the economy of China. Some hydroelectric stations (Liutiao-hsia and the Sang-meng) are already built.

The richest deposits of useful minerals which are here (iron ore, coal, petroleum, etc.) caused the intensive development of the petroleum, chemical, and metallurgical industries and the rapid growth of cities (Lan-chou, Pao-t'ou, etc.) Meanwhile, this region, the so-called Kansu corridor, is distinguished by a high, although extremely varied, in different parts, seismic activity. The earthquakes which occurred here in 1920 and in 1927 belong to the class of general catastrophes ($M=8.5$). The region is characterized by the diversity and complexity of the relief and tectonics. It is interesting to note that certain seismically active parts are located in regions not distinguished by the intensity of geomorphologically expressed tectonic movements, while the mountain structures of Nan'shang and K'u-k'u-no-erg are relatively passive.

It is, therefore, natural that Chinese scientists expressly selected this region as the principal object for conducting detailed, complex seismo-geological investigations with the aim of developing methods of seismic-regioning and earthquake forecasting.

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As far back as 1954, after two destructive earthquakes (Shang-tan and Min-ch'in) in the Kansu corridor, a network of four seismic stations equipped with low-sensitivity mechanically-recording seismographs was created. A large number of repeated shocks were recorded with these instruments. Three general type reference stations were organized in succeeding years in Lan-chou, Sian, and Pao-t'ou. The organization of a local group of four regional stations was undertaken in 1958 near Lan-chou.

It was impossible to obtain effective work from the group at once because of the absence of experience in similar investigations and also because modern activity in the form of accumulations of epicenters appeared outside the polygon of the stations. The observed accumulation of epicenters in the northwestern part of the Kansu corridor is also the object of important investigations. A new group of eight to ten stations equipped with instruments of varied sensitivity, capable of recording earthquakes of different intensity from very weak up to destructive, will be organized in 1959. In succeeding years, in connection with the complexity and the variety of the geological apparatus of a number of stations, it is proposed to bring the number of stations up to 40-60 in order to embrace all of the region and to have the possibility of making a comparative study of the seismic regime of the separate parts.

An extensive seismological examination of the region is also planned. In Lan-chou, an affiliate of the Geophysics Institute of the Academia Sinica was created, in which 2-year courses for training the personnel of the stations were organized.

The instrument group of the Geophysics Institute has developed original seismic instruments, particularly a quite modern seismograph, with mechanical recording and magnetic damping, for earthquakes of medium intensity (up to 6 degrees). In this instrument, the arrangement for transmitting movements of the inert mass to the amplifying lever is very successfully realized. A short-period seismograph with electron multiplication and a pen-galvanometer for writing on soot-coated paper are also very promising for regional investigations. The parameters of the instrument: period of the pendulum $T_M = 1$ second; period of the galvanometer $T_g = 0.3$ seconds. The amplification is 40,000 in an interval of periods from 0.1-0.8 seconds.

The work of the network of Chinese reference seismic stations, recording a large number of distant and near earthquakes, makes it possible to increase the accuracy of localizing the epicenters of earthquakes and to estimate their intensity by instrumental methods. ("The Development of Seismology in China," by D. A. Kharin; Moscow, Vestnik Akademii Nauk No 8, Aug 59, pp 59-61)

Study on Waves Reflected From a Thin Layer

Kinematic and dynamic conditions in which, for determining the spectra of reflected waves, it is possible to make use of Rayleigh formulas obtained for reflections of plane sinusoidal stationary waves from a thin layer (acoustical case) are examined. The spectral peculiarities of reflected waves for different velocity differentiations of the media and for different angles of incidence of the waves on the thin layer are considered on the basis of an analysis of the given formulas. The influence of absorption in the medium by the coating of the thin layer on the spectra of the reflected waves is examined. ("On Certain Spectral Peculiarities of Waves Reflected From Thin Layers," by I. S. Berzon, Institute of the Physics of the Earth, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 5, May 59, pp 641-657)

V. ARCTIC AND ANTARCTIC

Research Continues on Ostrov Kheysa

The diesel electric ship Ob' sailed from Arkhangel'sk to Zemlya Frantsa Iosifa. Aboard the ship were more than 30 scientific associates of the geophysical observatory "Druzhnaya," located on Ostrov Kheysa. The ship also carried equipment, industrial goods, and food supplies for the Soviet polar scientists.

The "Druzhnaya" observatory, headed by V. I. Gerasimenko, has been in operation for 2 years, conducting research under the IGY program.

Interesting information has been obtained in studying problems of the modern physics of cosmic rays, terrestrial magnetism, earth currents, auroras, and the ionosphere. Investigations of the upper atmosphere are conducted with the help of meteorological rockets. The data obtained by the observatory are processed in scientific research institutions of Moscow and Leningrad. ("En Route to Ostrov Kheysa"; Moscow, Vodnyy Transport, 27 Aug 59)

Antarctic Winter Weather

On 21 August, the sun reappeared above the horizon at the south geomagnetic pole. However, the antarctic winter is still continuing. This is the coldest time of the year in this region; the temperature is usually around minus 75 degrees Centigrade. On 23 and 24 August, the lowest air temperature of this year was recorded at minus 85.7 degrees. The severe cold is aggravated by continuous winds, blowing with a speed of 8-13 meters per second. These temperatures coincided with a period of minimum atmospheric pressure, which reached 450 millimeters.

Scientific observations are being conducted in all fields, and the instruments have been working without fail. With the reappearance of the sun, actinometric observations have been resumed. ("The Sun Above the Pole"; Moscow, Vodny Transport, 29 Aug 59)

Fifth Antarctic Expedition

Preparations for the Fifth Soviet Antarctic Expedition are now being concluded. The expedition will be headed by Ye. S. Korotkevich, Candidate of Geographical Sciences.

The work on geophysical cooperation in Antarctica will continue. At present, the Arctic and Antarctic Institute is completing the staffing of the expedition, as well as the preparation of scientific equipment and all necessary materials for work in the Antarctic.

Members of the expedition will continue the work at three stations established by Soviet scientists in Antarctica, i.e., at Mirnyy, Vostok, and Lazarev. In addition to stationary observations, scientists will conduct complex field research. As in the case of previous expeditions, the new one will have several special detachments, including geophysical, aerometeorological, glaciological, geological-geographical, aviation, and transport teams. They will carry out sled-tractor traverses, assisted by airplanes. Ice reconnaissance will be conducted from the air, as well as aerial photo survey, magnetic survey, and aerometeorological observations.

One of the largest mountain systems in Antarctica is the area on Queen Maud Land, extending from east to west for almost 1,000 kilometers. The geological party of the Fourth Expedition, which worked in this region during the latter part of February 1959 made a number of interesting observations. The block mountains in this area rise about 1-2 kilometers above the surface of the ice sheet. Some of the most ancient rock formations on the Earth have been discovered in this region; their age has been estimated at almost 1.5 billion years. Soviet geologists have set themselves the task of compiling the first geological map of this vast mountain area.

The approach to the mountains is blocked by huge glaciers, which present great difficulties for overland transport. The Soviet expedition will make use of airplanes, as well as snow vehicles which have proved themselves in the past for work in the Antarctic.

The expedition includes many scientists who are very familiar with work conditions on the antarctic continent.

The expedition will leave for Antarctica during the first part of November. ("Fifth Antarctic Expedition"; Askhabad, Turkmenskaya Iskra, 5 Sep 59)

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